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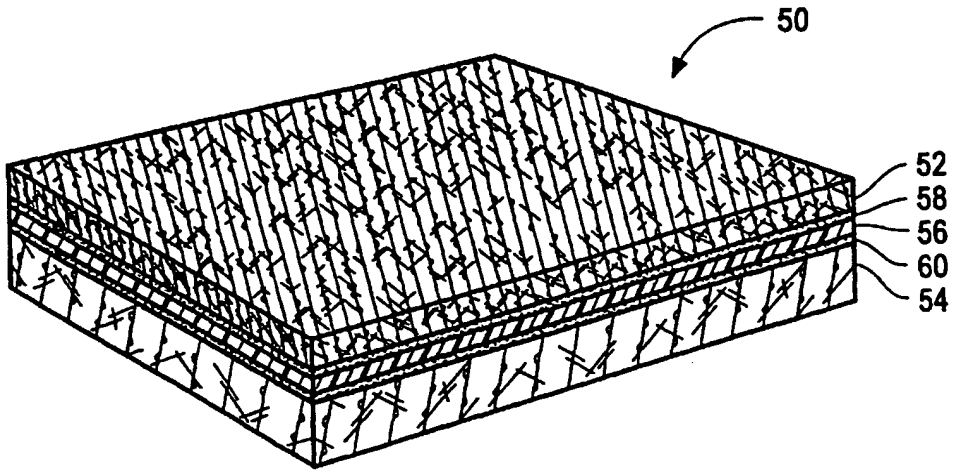
(54) Title: LAYERED CLEANING SHEETS



(57) Abstract: Layered cleaning sheets (10, 30, 50), including a layer of electret material (12, 32, 52) and a layer of absorbent material (14, 34, 54), are described. The electret material layer is particularly suitable for removing particulate materials, such as, but not limited to dust and soil, and is at least partially or semi-impervious to liquid materials. The absorbent material layer is particularly suitable for absorbing relatively large amounts of liquid materials, such as, but not limited to water. Additional layers, such as, but not limited to adhesives (36, 58, 60) and barriers (56) can be interposed between the electret and absorbent material layers in order to provide enhanced durability and imperviousness to liquid materials.

WO 01/22858 A1

LAYERED CLEANING SHEETS

Field Of The Invention

The present invention relates generally to cleaning materials and more particularly to layered cleaning sheets having a layer of electret material and a layer of absorbent material.

Background And Summary Of The Invention

The advent of cleaning materials, such as cleaning sheets, cloths, towels, wipes and the like, has greatly aided in the ability of consumers to clean up and remove particulate and liquid materials from various surfaces.

However, conventional cleaning materials, such as electrostatically charged materials or adhesive-containing materials (e.g., wipes, lint brushes, feather dusters, adhesive rollers, and the like), are typically only suitable for picking up particulate materials, such as dust, lint, hair, soil and the like, and are generally unsuitable for cleaning and removing liquid materials due, in part, to their inability to absorb sufficient amounts of the liquid materials. Thus, these cleaning materials can only be effectively used when the material to be removed is completely, or at least substantially, comprised of particulate material (i.e., there is very little or no liquid present in or near the particulate material to be removed).

Conversely, other conventional cleaning materials, such as highly absorbent cloth and fibrous materials (e.g. paper towels, cloth towels, and the like), are particularly well-suited for picking up liquid materials, such as water. However, they are generally unsuitable for cleaning and removing particulate materials due, in part, to their inability to attract and retain the particulate materials. Thus, these materials can only be effectively used when the material to be removed is completely, or at least substantially, comprised of liquid material (i.e., there is very little or no particulate material present in or near the liquid material to be removed). Additionally, these highly absorbent cloth and fibrous materials tend to allow the liquid materials to penetrate completely through the material, thus causing the user's hand to become soiled by the liquid material that is being removed. This situation is especially unsatisfactory if the liquid material has an objectionable odor or contains pathogenic material.

As a result, the consumer must purchase and store both types of conventional cleaning materials in order to deal with any future cleaning needs, whether they be for liquid or particulate materials.

Therefore, there exists a need for a cleaning sheet that is capable of cleaning particulate materials and liquid materials equally well, while protecting the user's hand from becoming soiled when cleaning liquid materials.

In accordance with one embodiment of the present invention, a cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface is provided, comprising a layer of electret material, and a layer of absorbent material adjacent to the layer of electret material.

In accordance with another embodiment of the present invention, a cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface is provided, comprising a layer of electret material, a layer of absorbent material adjacent to the layer of electret material, and a layer of adhesive material disposed between the layer of electret material and the layer of absorbent material.

In accordance with still another embodiment of the present invention, a cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface is provided, comprising a layer of electret material, a layer of absorbent material adjacent to the layer of electret material, and a layer of barrier material disposed between the layer of electret material and the layer of absorbent material.

In accordance with still another embodiment of the present invention, a cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface is provided, comprising a layer of electret material, a layer of absorbent material adjacent to the layer of electret material, a layer of barrier material disposed between the layer of electret material and the layer of absorbent material, a layer of adhesive material disposed between the layer of electret material and the layer of barrier material, and a layer of adhesive material disposed between the layer of barrier material and the layer of absorbent material.

Brief Description Of The Drawings

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

Figure 1 is a perspective view of a dual layer cleaning sheet, in accordance with one embodiment of the present invention;

Figure 2 is a cross-sectional view of the dual layer cleaning sheet depicted in Figure 1;

Figure 3 is a perspective view of a multi-layer cleaning sheet, in accordance with a first alternative embodiment of the present invention;

Figure 4 is a cross-sectional view of the multi-layer cleaning sheet depicted in Figure 3;

Figure 5 is a perspective view of a multi-layer cleaning sheet, in accordance with a second alternative embodiment of the present invention; and

Figure 6 is a cross-sectional view of the multi-layer cleaning sheet depicted in Figure 5.

The same reference numerals refer to the same parts throughout the various Figures.

Detailed Description Of The Preferred Embodiments

The layered cleaning sheets of the present invention are particularly suitable for cleaning and removing particulate material (e.g., dust, hair, lint, soil, and the like) as well as liquid material (e.g., water, and the like). The layered cleaning sheets of the present invention are preferably used on substantially hard or rigid surfaces (e.g., tables, shelving, floors, ceilings, hard furnishings, household appliances, and the like); however, it should be appreciated that the layered cleaning sheets of the present invention may be used on relatively softer surfaces as well (e.g., rugs, carpets, soft furnishings, linens, clothing, and the like). The layered cleaning sheets of the present invention can be washed, dried, and re-used over and over again over an extended period of time without any substantial diminishment of their cleaning properties, tearing, pilling, or changes in dimensional stability.

With reference to Figures 1 and 2, a dual layer cleaning sheet **10**, in accordance with one embodiment of the present invention, is comprised primarily of a first layer **12** of electret material and a second layer **14** of absorbent material. The designation of "first" and "second" layers are used for reference purposes only and is not meant to limit the scope of the present

invention. The exact dimensions of the cleaning sheet **10** are not thought to be critical to the success of the present invention; thus, the cleaning sheet **10** can be configured in a variety of shapes.

The first layer **12** may be fastened, attached, or otherwise secured to the second layer **14** by any number of conventional methods, such as, but not limited to stitching (e.g., along the periphery, or alternatively, at predetermined points so as to form a "checkerboard", "cross", "crisscross", or any other desired pattern). The exact manner in which the first layer **12** is fastened, attached, or otherwise secured to the second layer **14** is not thought to be critical provided that the two respective layers do not separate from one another, for example, during routine use.

The electret material is primarily intended to be used for the cleaning and removal of particulate material, whereas the absorbent material is primarily intended to be used for the cleaning and removal of liquid material. As will be described herein, the particular features of the materials comprising each of the two layers make them particularly suitable for their intended uses.

The first layer **12** is preferably comprised of a plurality of fibers. The fibers can be comprised of synthetic materials, such as, but not limited to, thermoplastics. The thermoplastics can include, without limitation, polypropylene, polyethylene, polyester, nylon, rayon, and acrylic.

The physical dimensions of the first layer **12** are not thought to be critical; however, the first layer **12** is preferably a relatively thin (as compared to the second layer **14**), single planar sheet of woven electret fibers. Preferably, the first layer **12** has a shape and configuration similar to that of the second layer **14**. It is believed that the fiber thickness and length are not critical to the success of the present invention provided that the resulting first layer **12** is sufficiently thin and flexible to clean and remove particulate material. Preferably, the denier values (i.e., the weight of 9000 meters of a single filament fiber) of the fibers of the first layer **12** are in the range of about 0.5 to about 4. Preferably, the thickness values of the fibers of the first layer **12** are in the range of about 0.05 to about 0.2 inches, with about 0.05 to about 0.1 inches being highly preferred. Preferably, the density of the fibers of the first layer **12** is such that there are no voids greater than 100 microns wide, and more preferably, no greater than 20 microns wide.

The first layer 12 can be constructed by any number of conventional methods, including, but not limited to, wet laid, dry laid, hydroentangled, spun-bound, needle punches, and the like.

The thermoplastic materials are preferably suitable for the generation of a permanent electrostatic charge on the surface of the fibers. These permanently electrostatically charged materials are generally referred to as electret materials. A discussion of electret materials, and methods of producing the same, can be found in U.S. Patent Nos. 3,998,916 issued to van Turnhout; 4,178,157 issued to van Turnhout et al.; 4,215,682 issued to Kubik et al.; 4,308,223 issued to Stern; 4,375,718 issued to Wadsworth et al.; 4,486,365 issued to Kliemann et al.; 4,789,504 issued to Ohmori et al.; and 5,726,107 issued to Dahringer et al., the specifications of all of which are expressly incorporated herein by reference.

An electret material, also generally referred to as an electret, is a dielectric material which retains an electrostatic charge for many years and as such can be considered the electrostatic equivalent of a permanent magnet. Thus, while the magnet is a permanent source of external magnetic field, the electret is a permanent source of electric field. Electrets are usually produced in sheet or film form with one surface positively charged and the other surface negatively charged.

When an electret is formed, the material is said to be polarized; i.e., the charges have been oriented in a preferred direction. This polarization can involve either heterocharges, homocharges, or both, depending on the material used and the method of preparation.

When the charges are arranged in positive-negative pairs and aligned in the same direction throughout the material it is said to be heterocharged. When individual charges collect on the surface of the electret material it is said to be homocharged. Here, charges of the same kind are fixed in one surface with the opposite charges on the other surface.

Recently, interest has centered on the production of homocharged-only electrets, where in essence the effect is simply the ability of some materials to retain surface electrostatic charge for considerable periods of time. This interest coincided with the advent of thermoplastics in flexible film form. These thermoplastics retain charge for ling periods of time and because of their very good insulating properties and roll film form, permit simpler continuous charging techniques. Electrets of this type have been made from

polyethylene, polypropylene, polystyrene, polycarbonate, and many other types of thermoplastics. The electrets of the present invention are preferably homocharged-only electrets.

In operation, the electret materials of the present invention have demonstrated good dry dust and particulate soil removal from hard surfaces in comparison to conventional fabric or fibrous cleaning materials. This is due to the fact that the electret materials actively attract particulate material during the cleaning process, as opposed to conventional cloth or fibrous cleaning materials which merely physically contact the particulate material, with the particulate material adhering to, or being enveloped by, the conventional cloth or fibrous cleaning material.

To illustrate the attractive features of the electret material comprising the first layer **12** of the cleaning sheet **10**, a comparative test was conducted among a conventional cotton cleaning cloth (e.g., 100% flannel cloths) obtained from Darra (North Hollywood, California), a conventional generic brand polyester cleaning cloth, and a cleaning cloth (sold under the tradename ECM-85 PFP) comprised of a single layer of electret fibers obtained from All Felt (Ingleside, Illinois). The comparative testing procedure is presented in Example I, below:

Example I

A standard dust cabinet was provided having a total internal volume of 0.468 cubic meters. A 241 centimeter x 127 centimeter section of furniture surface (oak with high gloss nitrocellulose lacquer) was cleaned to remove any dust, polish, fingerprints and was placed inside the cabinet. After the cabinet was sealed, and thirty minutes before the testing procedure was commenced, 10 grams of a 50:50 weight ratio mixture of particulate matter comprised of sieved (100 micron) vacuum cleaner dust (i.e., dust) and Bandy Black research clay (i.e., dirt) (Textile Innovators Corp., Windsor, North Carolina) was introduced into the cabinet by a Vent-Axia TX7IL fan unit having a maximum flow rate of 645 cubic meters/hour. After 2 minutes of circulation, the fan unit was stopped and the particulate matter was allowed to settle for one hour. Several samples of each type of cleaning cloth were prepared into 21.5 centimeter x 12.5 centimeter strips. A PLEDGE GRAB-IT™ sweeper

unit with a base footprint of 10 centimeters x 25.5 centimeters was divided using a marker pen into two sections, both 10 centimeters x 12.5 centimeters, i.e., the base of the sweeper unit was divided into two sections, each of which had a corresponding pair of fabric grips on the upper surface of the sweeper unit. For cloths designed to be used in a particular direction (i.e., the direction of stroke of the sweeper unit) the longer dimension was taken to the direction of the stroke. Each test cloth was weighed and then inserted on one side of the sweeper unit so that two cloths under test would just touch in the middle and cover the full extent of the sweeper unit. For convenience, the handle attached to the sweeper unit was shortened to approximately 30 centimeters long. The cabinet was opened and the sweeper unit/cloth assembly was wiped over the furniture surface (three lateral sweeps so that each cloth covers three areas of dusted surface 127 centimeters long). With care not to dislodge any particulate matter, the cloths were removed and re-weighed. Each cloth was then given a firm shake and then re-weighed to determine the amount of particulate matter retained by the cloth. The results of this testing procedure are presented in Table I.

Table I

Product Type and Sample Number	Cloth Mass (grams)	Cloth and Particulate Material Mass (grams)	Particulate Material Mass (grams)	Post-Shaking Cloth and Particulate Material Mass (grams)	Residual Particulate Material Mass (grams)
Cotton Duster #1	3.98	4.18	0.20	4.06	0.08
Cotton Duster #2	3.99	4.19	0.20	4.03	0.04
Cotton Duster #3	3.98	4.18	0.20	4.03	0.05
Cotton Duster #4	4.00	4.22	0.22	4.04	0.04
Cotton Duster #5	3.99	4.22	0.23	4.04	0.05
Cotton Duster #6	3.98	4.18	0.20	4.04	0.06
Cotton Duster #7	3.99	4.18	0.19	4.04	0.05
Cotton Duster #8	4.00	4.22	0.22	4.04	0.04
Cotton Duster #9	3.98	4.17	0.19	4.02	0.04
Cotton Duster #10	3.99	4.18	0.19	4.04	0.05
Average	3.99	4.19	0.20	4.04	0.05
Polyester cloth #1	1.42	1.60	0.18	1.52	0.10
Polyester cloth #2	1.41	1.59	0.18	1.51	0.10
Polyester cloth #3	1.40	1.59	0.19	1.49	0.09
Polyester cloth #4	1.41	1.59	0.18	1.51	0.10
Polyester cloth #5	1.39	1.57	0.18	1.49	0.10
Polyester cloth #6	1.41	1.58	0.18	1.51	0.10
Polyester cloth #7	1.42	1.61	0.19	1.53	0.11

Table 1 continued

Product Type and Sample Number	Cloth Mass (grams)	Cloth and Particulate Material Mass (grams)	Particulate Material Mass (grams)	Post-Shaking Cloth and Particulate Material Mass (grams)	Residual Particulate Material Mass (grams)
Polyester cloth #8	1.41	1.58	0.17	1.50	0.09
Average	1.41	1.59	0.18	1.51	0.10
Electret cloth #1	2.01	2.31	0.30	2.21	0.20
Electret cloth #2	2.00	2.31	0.31	2.20	0.20
Electret cloth #3	2.02	2.33	0.31	2.23	0.21
Electret cloth #4	2.02	2.31	0.29	2.20	0.18
Electret cloth #5	2.00	2.30	0.30	2.19	0.19
Electret cloth #6	2.01	2.30	0.29	2.21	0.20
Electret cloth #7	2.00	2.30	0.30	2.19	0.19
Electret cloth #8	2.01	2.30	0.29	2.20	0.19
Average	2.01	2.31	0.30	2.20	0.20

As the results in Table I indicate, the cleaning cloth having a layer comprised of electret fibers, in accordance with the present invention, not only attracted more particulate matter than the other types of cleaning cloths, but also retained more particulate matter after being shaken.

The chemical (e.g., thermoplastic) and physical (e.g., hydrophobic) nature of the electret materials of the present invention necessarily means that they have relatively low liquid absorbency. Accordingly, a benefit of this relatively low level of liquid absorbency is that the electret material of the first layer **12** functions as a semi-impervious barrier to the liquid materials, i.e., the electret material of the first layer **12** is at least partially impervious to the liquid materials. Thus, when the second layer **14** of the cleaning sheet **10** is being used

for cleaning and/or removal of liquid material, the first layer **12** functions to prevent any substantial amount of the liquid material from passing through the first layer **12** and soiling the user's hand. This feature is especially beneficial if the liquid material has an objectionable odor or contains pathogenic material.

To illustrate the imperviousness features of the material comprising the first layer **12** of the cleaning sheet **10**, a comparative test was conducted among a conventional wool cleaning cloth, a conventional cotton cleaning cloth (e.g., a duster), a conventional cellulosic cleaning cloth (e.g., a paper towel), and cleaning cloths comprised of non-electret synthetic fibers such as rayon, polyester, polypropylene, and nylon. The comparative testing procedure is presented in Example II, below:

Example II

Laminate cloths were constructed using, on the lower layer, a super-absorbent material comprising 30 weight percent Oasis FSA (Technical Absorbents, Ltd.), 50 weight percent Fluff PLP, and 20 weight percent thermal bondable fiber. The upper layer, which was non-electret, comprised a fabric under test for water strike-through. The cloths were cut to 7.6 centimeter x 7.6 centimeter squares and stitched together at the edges only. One hundred ml of water was placed on a horizontal surface so that it formed a puddle. The cloth laminate was placed in the middle of the puddle, super-absorbent layer down so that the super-absorbent layer became saturated. The cloth laminate was left in contact with the water for 5 minutes. The cloth laminate was then placed on a separate surface and left for a further 5 minutes. The upper layer of the laminate cloth was gently touched with a finger and rated for dampness (i.e., initial dampness) on a ten-point scale, with 0 indicating no dampness and 10 indicating saturation. Once rated, the pad was pressed with three fingers and re-rated for the amount of dampness (i.e., final dampness) that was felt after the application of pressure. The results of this testing procedure are presented in Table II.

Table IITable IITable II

Cloth Material Type	Initial Dampness	Final Dampness
Wool	2	5
Cotton	3	6
Cellulose	6	9
Rayon	1	2
Polyester	0	1
Polypropylene	0	0
Nylon	0	1

As the results in Table II indicate, the cleaning cloth having a layer comprised of synthetic fibers (e.g., rayon, polyester, polypropylene, and nylon), in accordance with the present invention, did not allow a significant amount of water to penetrate therethrough, and in fact, the polypropylene material did not allow any water penetration (i.e., strike-through) whatsoever.

The second layer **14** is preferably comprised of an absorbent material, and still more preferably a super-absorbent material, that is capable of absorbing relatively large amount of liquid materials, especially water. A super-absorbent material is generally defined as a water-insoluble, water-swellable polymer material capable of absorbing water in an amount which is at least ten times the weight of the substance in its dry form. Additionally, super-absorbents also retain the absorbed liquid far better than conventional materials. Thus, once the liquid is absorbed by the super-absorbent material, it is difficult for the liquid to be released from the super-absorbent material.

Preferably, the super-absorbent material is formed into a plurality of fibers which are then formed into the second layer **14**. The super-absorbent fibers of the present invention are preferably absorbent of any liquid material, more preferably absorbent of any aqueous-based liquid material, and still more preferably absorbent of water.

A discussion of absorbent materials, including apparatuses and methods for producing the same, can be found in U.S. Patent Nos. 3,814,101 issued to Kozak; 3,886,941 issued to Duane et al.; 3,987,792 issued to Hernandez et al.; 4,062,817 issued to Westerman; 4,232,128 issued to Michel et al.; 4,328,279 issued to Meitner et al.; 4,360,015 issued to Mayer; 4,540,454 issued to Pieniak et al.; 4,606,958 issued to Haq et al.; 4,659,609 issued to Lamers et al.; 4,977,892 issued to Ewall; 5,591,155 issued to Nishikawa et al.; 5,658,268 issued to Johns et al.; 5,658,269 issued to Osborn et al.; 5,658,270 issued to Lichstein; 5,704,928 issued to Morita et al.; 5,704,929 issued to Bein; 5,704,930 issued to Lavash et al.; 5,704,931 issued to Holtman et al.; 5,704,932 issued to Hibbard; 5,705,249 issued to Takai et al.; 5,713,884 issued to Osborn et al.; 5,728,082 issued to Gustafsson et al.; 5,728,084 issued to Palumbro et al.; 5,713,855 issued to Jorgenson et al.; 5,713,881 issued to Rezai et al.; 5,713,883 issued to Hsieh; 5,713,886 issued to Sturino; 5,725,518 issued to Coates; 5,728,085 issued to Widlund et al.; 5,728,081 issued to Baer et al.; 5,766,212 issued to Jitoe et al.; 5,766,213 issued to Hackman et al.; 5,772,649 issued to Siudzinski; 5,772,650 issued to Mizutani; 5,779,689 issued to Pfeifer et al.; 5,779,690 issued to Gustafsson et al.; 5,779,691 issued to Schmitt; 5,779,692 issued to Lavash et al.; 5,785,696 issued to Inoue et al.; 5,785,697 issued to Trombetta et al.; 5,785,698 issued to Van Item; 5,785,699 issued to Schmitz; 5,786,056 issued to Komine et al.; 5,792,129 issued to Johansson et al.; 5,792,131 issued to Mizutani; 5,792,132 issued to Garcia; 5,795,345 issued to Mizutani et al.; 5,795,346 issued to Achter et al.; 5,795,347 issued to Roe et al.; 5,795,349 issued to Lavash et al.; 5,797,894 issued to Cadieux et al.; 5,800,416 issued to Seger et al.; 5,800,417 issued to Gogerg-Wood et al.; 5,800,418 issued to Ahr; 5,800,419 issued to Soga et al.; 5,803,920 issued to Gilman; 5,810,796 issued to Kimura et al.; 5,810,797 issued to Menard et al.; 5,810,798 issued to Finch et al.; 5,810,799 issued to Slater; 5,810,800 issued to Hunter et al.; 5,814,034 issued to Widlund et al.; 5,814,035 issued to Gryskiewicz et al.; 5,814,036 issued to Ronnberg et al.; 5,814,037 issued to Coates; 5,817,076 issued to Fard; 5,817,077 issued to Foley et al.; 5,817,079 issued to Bergquist et al.; 5,817,394 issued to Alikhan et al.; 5,817,400 issued to Chen et al.; 5,820,615 issued to Koczab; 5,820,619 issued to Chen; 5,855,573 issued to Johansson; 5,858,011 issued to Brown et al.; 5,858,012 issued to Yamaki et al.; 5,858,013 issued to Kling; and 5,916,507 issued to Dabi et al., the specifications of all of which are expressly incorporated herein by reference.

The second layer **14** is preferably comprised a plurality of polymeric fibers (e.g., thermoplastics) comprised of up to about 70 weight percent of a cross-linked acrylate copolymer (preferably partially neutralized to the sodium salt) that acts as a water super-absorbent. Super-absorbent materials, in accordance with the present invention, are readily commercially available under the tradenames LANSEAL F™ (Toyobo Company, Limited, Osaka, Japan), FIBERSORB™ (DuPont, Wilmington, Delaware), and OASIS™ (Technical Absorbents Limited, Grimsby, England).

The super-absorbent fibers of the present invention have been demonstrated to absorb and retain up to about eighty times their own weight of water, whereas conventional natural fibers, such as cotton, wool, cellulose, and even synthetic fibers, such as nylon, polypropylene, and rayon, absorb only around up to about seven times their own weight. To illustrate the differences in absorptive capacity a comparative test was conducted among the various materials and the super-absorbent material of the present invention. The comparative testing procedure is presented in Example III, below:

Example III

Weighed amounts of fabric samples of known fiber composition were placed into a beaker containing an excessive amount of water and left for 10 minutes. The fabric samples were then removed and allowed to drip dry for 30 seconds and then re-weighed to determine the amount of water retained. The results of the testing procedure are presented in Table III.

Table IIITable IIITable III

Fabric Fiber Type	Initial Mass of the Fabric (grams)	Initial Mass of the Fabric and Retained Water (grams)	Mass of the Water Retained (grams)	Weight Percentage of the Water Retained (grams)
OASIS™ super-absorbent	5.0	389.0	384.0	7680% (i.e., 76.8 times the initial mass)
Cotton	5.0	40.8	35.8	716% (i.e., 7.16 times the initial mass)
Wool	5.0	38.6	33.6	672% (i.e., 6.72 times the initial mass)
Cellulose (paper towel)	5.0	31.8	26.8	536% (i.e., 5.36 times the initial mass)
Rayon	5.0	5.3	0.3	6% (i.e., 0.06 times the initial mass)
Nylon	5.0	5.1	0.1	2% (i.e., 0.02 times the initial mass)
Poly-propylene	5.0	5.1	0.1	2% (i.e., 0.02 times the initial mass)

As the results in Table III indicate, the fabrics comprised of natural fibers retain only about 5.36 to 7.16 times their initial mass of water. The fabrics comprised of synthetic fibers retain only about 0.02 to 0.06 times their initial mass of water. Conversely, the fabric comprised of super-absorbent material, in accordance with the present invention, retains nearly 80 times its own weight in water.

The advantage of employing super-absorbent fibers is two-fold. First, the fibers permit the quick absorption of liquid materials (e.g., spills) far more efficiently than conventional paper towels or cloth towels. Second, when used in conjunction with an aqueous-based cleaner (e.g., a surfactant), the fibers improve the efficiency of the cleaner, as well as particulate removal from a surface, which is especially important on surfaces that can be damaged by moisture.

The second layer **14** optionally contains other natural or synthetic fibers to increase tensile strength of this layer, such as, but not limited to wool, cotton, cellulose, polypropylene, polyethylene, polyester, nylon, rayon, and acrylic.

The physical dimensions of the second layer **14** are not thought to be critical; however, the second layer **14** is preferably a relatively thick (as compared to the first layer **12**), single planar sheet of non-woven absorbent fibers. By way of a non-limiting example, the second layer **14** can be up to about 0.25 inches in diameter. Preferably, the second layer **14** has a shape and configuration similar to that of the first layer **12**.

With reference to Figures 3 and 4, a multi-layer cleaning sheet **30**, in accordance with a first alternative embodiment of the present invention, is comprised primarily of a first layer **32** of electret material (as previously described), a second layer **34** of absorbent material (as previously described), and a third layer **36** of adhesive material disposed between the first layer **32** and the second layer **34**. The designation of "first", "second", and "third" layers is for reference purposes only and is not meant to limit the scope of the present invention.

The third layer **36** of adhesive material may be applied to any suitable surface of either, or both, the first layer **32** and/or the second layer **34**. By way of a non-limiting example, the adhesive material may be applied as a solid layer, a continuous pattern (e.g., a circle or serpentine pattern), a discontinuous pattern (e.g., a series of lines or a matrix of dots), or any other desired pattern.

The third layer **36** of adhesive material is intended to function as a way to bond (physically and/or chemically), fasten, attach, or otherwise secure the first layer **32** to the second layer **34**. Additionally, the third layer **36** of adhesive material is intended to function as an impervious, or at least a semi-impervious, barrier against liquid materials penetrating through to the first layer **32**, i.e., the adhesive material of the third layer **36** is at least partially impervious to the liquid materials. Preferably, the adhesive material is water-proof and otherwise impervious to liquid materials. By way of a non-limiting example, the semi-impervious nature of the first layer **32** can be enhanced or reinforced by employing a solid layer of water-proof, and preferably liquid impervious, adhesive material. Furthermore, the third layer **36** of adhesive material also adds strength and durability to the cleaning sheet **30**.

The multi-layer cleaning sheet **30** is intended to function in the same manner as the dual-layer cleaning sheet **10**, i.e., the first layer **32** of electret material is primarily intended to clean and remove particulate material, whereas the second layer **34** of absorbent material is primarily intended to clean and remove liquid material.

With reference to Figures 5 and 6, a multi-layer cleaning sheet **50**, in accordance with a second alternative embodiment of the present invention, is comprised primarily of a first layer **52** of electret material (as previously described), a second layer **54** of absorbent material (as previously described), a third layer **56** of barrier material disposed between the first layer **52** and the second layer **54**, an optional fourth layer **58** of adhesive material disposed between the first layer **52** and the third layer **56**, and an optional fifth layer of adhesive **60** disposed between the second layer **54** and the third layer **56**. The adhesive layers **58** and **60**, respectively, are described as being optional because the third layer **56** of barrier material can be bonded (physically and/or chemically), fastened, attached, or otherwise secured to the first layer **52** and the second layer **54** without resort to adhesives. For example, the third layer **56** of barrier material can be stitched to the first layer **52** and the second layer **54**, or vice verse. The designation of "first", "second", "third", "fourth", and "fifth" layers is for reference purposes only and is not meant to limit the scope of the present invention.

In this embodiment, the third layer **56** of barrier material is employed to further improve the imperviousness of the first layer **52** against the penetration of liquid materials. The barrier material is preferably comprised of at least a partially or semi-impervious material, and still more preferably an impervious material, such as, but not limited to,

thermoplastics, especially those that are capable of being formed into films. By way of a non-limiting example, suitable materials include natural materials such as rubber, latex, and the like, as well as synthetic materials such polyvinyl chloride, polyethylene, polyurethane, and the like. The barrier material should preferably extend to, and along, the periphery of both the first layer **52** and the second layer **54** in order to provide a continuous barrier against the penetration of liquid materials.

By way of a non-limiting example, the two adhesive layers **58** and **60**, respectively, are provided in order to bond, fasten, attach, or otherwise secure the first layer **52** and the second layer **54** to the respective surfaces of the third layer **56** of barrier material. One, or both, of the adhesive layers **58** and **60** can be made impervious, or at least partially or semi-impervious, to liquid materials, thus further enhancing the imperviousness of the first layer **52** against the penetration of liquid materials. Furthermore, the third layer **56** of barrier material, as well as the fourth and fifth layers **58** and **60** of adhesive material, also add increased strength and durability to the cleaning sheet **50**.

The multi-layer cleaning sheet **50** is intended to function in the same manner as the previously described cleaning sheets **10** and **30**, i.e., the first layer **52** of electret material is primarily intended to clean and remove particulate material, whereas the second layer **54** of absorbent material is primarily intended to clean and remove liquid material.

The foregoing description is considered illustrative only of the principles of the invention. Furthermore, because numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and process shown as described above. Accordingly, all suitable modifications and equivalents that may be resorted to that fall within the scope of the invention as defined by the claims that follow.

Industrial Applicability

The present invention is highly versatile as it may be utilized to clean both substantially rigid surfaces such as countertops and floors as well as softer surfaces like rugs and carpeting. It can be manufactured with conventional manufacturing equipment and commercially available materials. Additionally, the cleaning sheets of the present invention may be washed and reused making them more environmentally sound than one-time use cleaning implements.

Claims

1. A cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface, comprising:

a layer of electret material; and

a layer of absorbent material adjacent to the layer of electret material.

2. The invention of claim 1, wherein the layer of electret material is capable of cleaning and removing the particulate materials from the surface.

3. The invention of claim 1, wherein the layer of absorbent material is capable of cleaning and removing the liquid materials from the surface.

4. The invention of claim 1, wherein the layer of electret material is at least partially impervious to the liquid materials.

5. The invention of claim 1, wherein the layer of electret material is comprised of a plurality of electret fibers.

6. The invention of claim 5, wherein the electret fibers are comprised of a thermoplastic material.

7. The invention of claim 6, wherein the thermoplastic material is selected from the group consisting of polyethylene, polypropylene, and combinations thereof.

8. The invention of claim 1, wherein the layer of absorbent material is comprised of a plurality of polymeric fibers.

9. The invention of claim 8, wherein the polymeric fibers comprise up to about 50% of a cross-linked acrylate copolymer.

10. The invention of claim 8, wherein the polymeric fibers are super-absorbent.

11. The invention of claim 1, further comprising a layer of adhesive material disposed between the layer of electret material and the layer of absorbent material.

12. The invention of claim 1, further comprising a layer of barrier material disposed between the layer of electret material and the layer of absorbent material.

13. The invention of claim 12, further comprising a layer of adhesive material disposed between the layer of electret material and the layer of barrier material.

14. The invention of claim 12, further comprising a layer of adhesive material disposed between the layer of absorbent material and the layer of barrier material.

15. A cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface, comprising:

a layer of electret material;

a layer of absorbent material adjacent to the first layer; and

a layer of adhesive material disposed between the layer of electret material and the layer of absorbent material.

16. The invention of claim 15, wherein the layer of electret material is capable of cleaning and removing the particulate materials from the surface.

17. The invention of claim 15, wherein the layer of absorbent material is capable of cleaning and removing remove the liquid materials from the surface.

18. The invention of claim 15, wherein the layer of electret material is at least partially impervious to the liquid materials.

19. The invention of claim 15, wherein the layer of electret material is comprised of a plurality of electret fibers.

20. The invention of claim 19, wherein the electret fibers are comprised of a thermoplastic material.

21. The invention of claim 20, wherein the thermoplastic material is selected from the group consisting of polyethylene, polypropylene, and combinations thereof.

22. The invention of claim 15, wherein the layer of absorbent material is comprised of a plurality of polymeric fibers.

23. The invention of claim 22, wherein the polymeric fibers comprise up to about 50% of a cross-linked acrylate copolymer.

24. The invention of claim 22, wherein the polymeric fibers are super-absorbent.

25. The invention of claim 15, wherein the layer of adhesive material is at least partially impervious to the liquid materials.

26. A cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface, comprising:

a layer of electret material;

a layer of absorbent material adjacent to the first layer; and

a layer of barrier material disposed between the layer of electret material and the layer of absorbent material.

27. The invention of claim 26, wherein the layer of electret material is capable of cleaning and removing the particulate materials from the surface.

28. The invention of claim 26, wherein the layer of absorbent material is capable of cleaning and removing the liquid materials from the surface.

29. The invention of claim 26, wherein the layer of electret material is at least partially impervious to the liquid materials.

30. The invention of claim 26, wherein the layer of electret material is comprised of a plurality of electret fibers.

31. The invention of claim 30, wherein the electret fibers are comprised of a thermoplastic material.

32. The invention of claim 31, wherein the thermoplastic material is selected from the group consisting of polyethylene, polypropylene, and combinations thereof.

33. The invention of claim 26, wherein the layer of absorbent material is comprised of a plurality of polymeric fibers.

34. The invention of claim 33, wherein the polymeric fibers comprise up to about 50% of a cross-linked acrylate copolymer.

35. The invention of claim 33, wherein the polymeric fibers are super-absorbent.

36. The invention of claim 26, wherein the layer of barrier material is comprised of a thermoplastic material.

37. The invention of claim 26, wherein the layer of barrier material is at least partially impervious to the liquid materials.

38. A cleaning sheet for cleaning and removing particulate materials and liquid materials from a surface, comprising:

a layer of electret material;

a layer of absorbent material adjacent to the layer of electret material;

a layer of barrier material disposed between the layer of electret material and the layer of absorbent material;

a layer of adhesive material disposed between the layer of electret material and the layer of barrier material; and

a layer of adhesive material disposed between the layer of barrier material and the layer of absorbent material.

39. The invention of claim 38, wherein the layer of electret material is capable of cleaning and removing the particulate materials from the surface.

40. The invention of claim 38, wherein the layer of absorbent material is capable of cleaning and removing the liquid materials from the surface.

41. The invention of claim 38, wherein the layer of electret material is at least partially impervious to the liquid materials.

42. The invention of claim 38, wherein the layer of electret material is comprised of a plurality of electret fibers.

43. The invention of claim 42, wherein the electret fibers are comprised of a thermoplastic material.

44. The invention of claim 43, wherein the thermoplastic material is selected from the group consisting of polyethylene, polypropylene, and combinations thereof.

45. The invention of claim 38, wherein the layer of absorbent material is comprised of a plurality of polymeric fibers.

46. The invention of claim 45, wherein the polymeric fibers comprise up to about 50% of a cross-linked acrylate copolymer.

47. The invention of claim 45, wherein the polymeric fibers are super-absorbent.

48. The invention of claim 38, wherein the layer of barrier material is comprised of a thermoplastic material.

49. The invention of claim 38, wherein the layer of barrier material is at least partially impervious to the liquid materials.

50. The invention of claim 38, wherein the layer of adhesive material disposed between the layer of electret material and the layer of barrier material is at least partially impervious to the liquid materials.

51. The invention of claim 38, wherein the layer of adhesive material disposed between the layer of barrier material and the layer of absorbent material is at least partially impervious to the liquid materials.

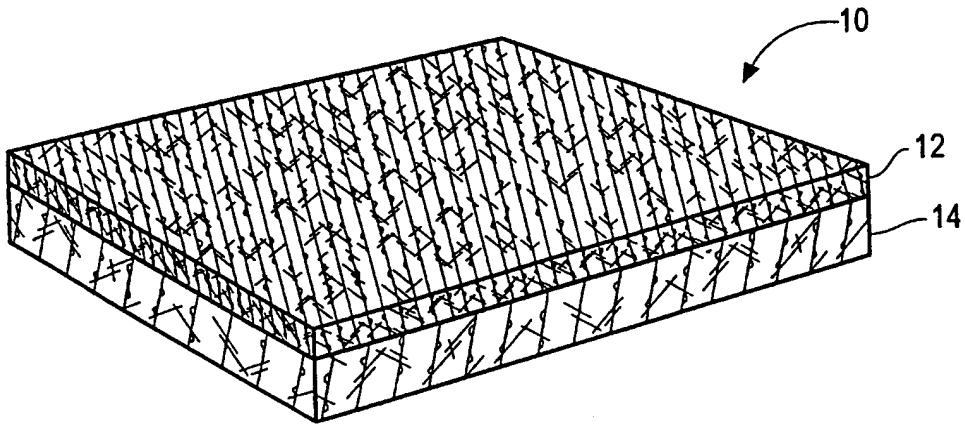


FIG. - 1

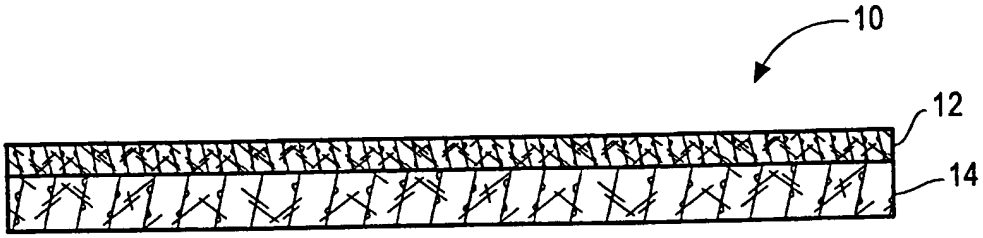


FIG. - 2

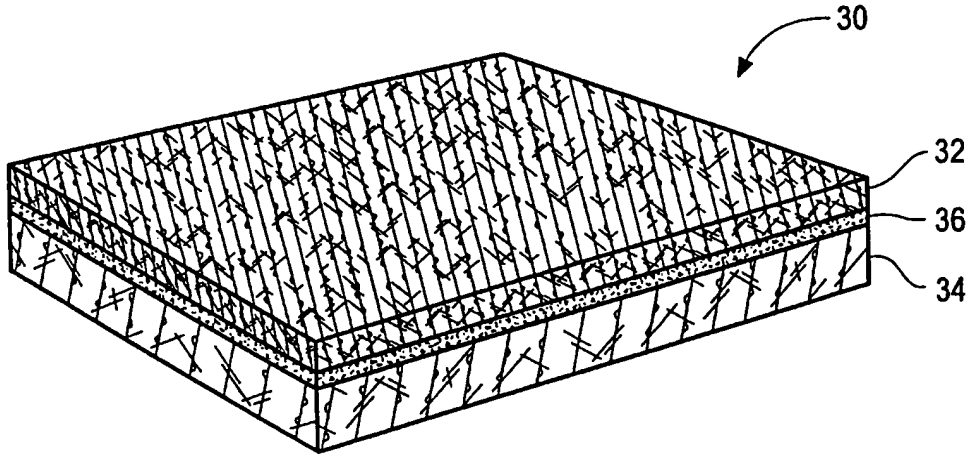


FIG. - 3

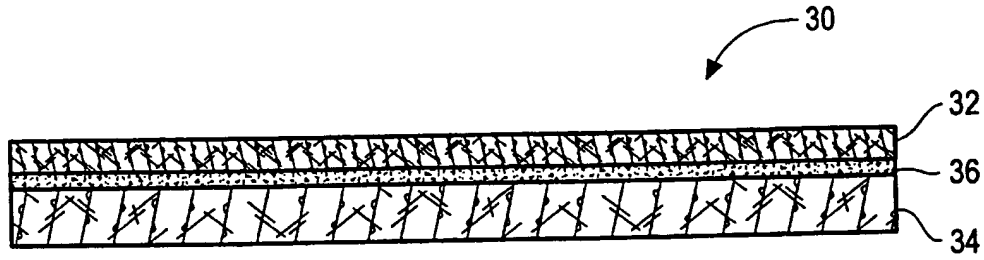


FIG. - 4

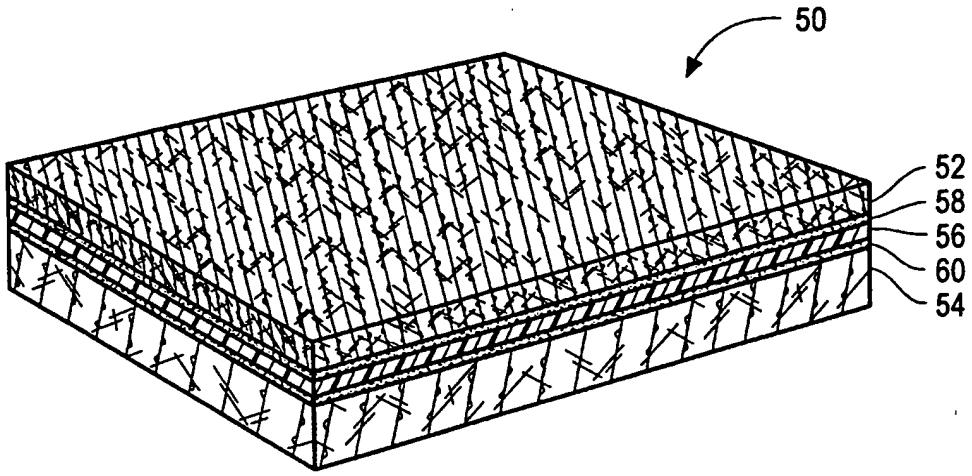


FIG. - 5

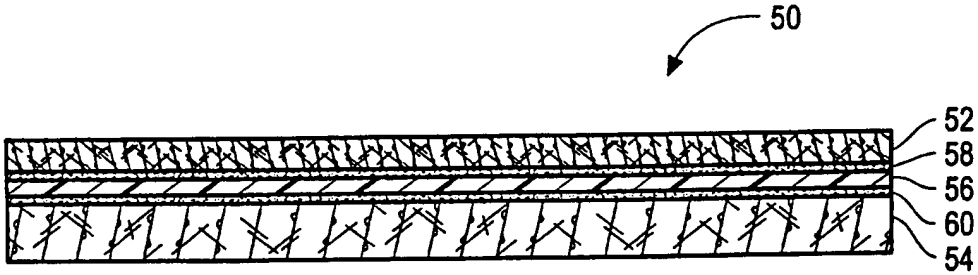


FIG. - 6

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/US 00/26480

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A47L13/16 A47L13/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 679 115 A (RENAUD P) 22 January 1993 (1993-01-22) the whole document	1-3,6,7, 11, 15-17, 20,21
A		26,38
A	GB 2 061 709 A (BEECHAM W J E) 20 May 1981 (1981-05-20) abstract page 1, line 113 -page 2, line 29 figures	1
A	EP 0 848 927 A (DANIELS H) 24 June 1998 (1998-06-24) abstract column 2, line 42 - line 48 figure A	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 December 2000	28/12/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Cabral Matos, A

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INTERNATIONAL SEARCH REPORT

Inter ɔnal Application No
PCT/US 00/26480

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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